

A waterbird survey on the coast of Quirimbas National Park, northern Mozambique

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Un inventaire des oiseaux d'eau sur la côte du Parc National de Quirimbas, Mozambique du nord.

Un inventaire des oiseaux d'eau a été réalisé en décembre 2009 sur neuf îles maritimes du Parc National de Quirimbas, Mozambique. Au total, 14.982 oiseaux de 34 espèces ont été comptés, parmi lesquels 82% étaient des migrateurs paléarctiques. Pour six espèces (Drome ardéole *Dromas ardeola*, Pluvier à front blanc *Charadrius marginatus*, Pluvier de Mongolie *C. mongolus*, Pluvier de Leschenault *C. leschenaultii*, Pluvier argenté *Pluvialis squatarola*, Sterne voyageuse *Sterna bengalensis*) le nombre dépassait le seuil de 1% du critère 6 de la Convention de Ramsar ; le parc se qualifie ainsi comme zone humide d'importance internationale. Deux tiers des oiseaux ont été observés sur quatre grands repositoires de marée haute loin de toute activité humaine, soulignant l'importance de contrôler les dérangements humains près de ces sites, qui couvrent moins de 4% de la zone inventoriée.

Summary. A waterbird survey was carried out in December 2009 on nine marine islands in Quirimbas National Park, Mozambique. We counted 14,982 individuals of 34 species. Eighty-two per cent of the birds were Palearctic migrants. For six species (Crab-plover *Dromas ardeola*, White-fronted Plover *Charadrius marginatus*, Lesser Sand Plover *C. mongolus*, Greater Sand Plover *C. leschenaultii*, Grey Plover *Pluvialis squatarola*, Lesser Crested Tern *Sterna bengalensis*) numbers exceeded the 1% Ramsar criterion; the park thus qualifies as a wetland of international importance. Two-thirds of the birds were observed in four large high-tide roosts far from human disturbance, highlighting the importance of controlling such activities close to these sites that cover less than 4% of the surveyed area.

Waterbirds are among the most threatened vertebrates, as they are entirely dependent on wetlands, which have been very strongly affected by human activities (Stroud *et al.* 2006). Recent estimates suggest that 45% of waterbird populations are decreasing or already extinct, with several species exhibiting precipitous declines and severely threatened with extinction (Davidson & Stroud 2006, Wetlands International 2006).

Among the causes linked to declines in waterbird numbers, habitat destruction is probably the most important (Stroud *et al.* 2006, Kirby *et al.* 2008). Consequently, conservation should focus on identifying and protecting key habitats and sites where the largest waterbird congregations occur. Various international agreements exist for the protection of wetlands as habitats for waterbirds. Among these, the Ramsar Convention (Kabii 1997, Ramsar Convention Secretariat 2006) calls for the protection of sites whose importance is evaluated through criteria such as the regular presence of at least 20,000 individuals or of 1% or more of the population of a species or subspecies of waterbird. In Africa, few sites have been evaluated against the Ramsar criteria and

many important waterbird areas probably remain unknown.

One of the most important migration routes, the 'West Asia/East Africa flyway', runs along the east coast of Africa and is used by more than 20 million Palearctic shorebirds (Davidson & Stroud 2006). Numerous other waterbirds, including intra-African migrants and residents, occur along Africa's eastern coast, which clearly has a pivotal role in the conservation of waterbird populations. Unfortunately, long stretches are almost unsurveyed and their role as waterbird sites is poorly known. In particular, the coast of northern Mozambique features as a blank spot in the distribution maps of migratory waterbirds (Scott & Rose 1996, Delany *et al.* 2009). As Mozambique is located near the end of the West Asia/East Africa flyway, it probably plays a key role as a staging site or final destination for Palearctic waterbirds during their seasonal migrations.

Quirimbas National Park comprises a vast ecosystem of wetlands on the coast of northern Mozambique. Apart from historical data from the Vincent expedition (Vincent 1933) and some recent preliminary work (Diagana & Dodman

2007, Wilson 2008), no information on the waterbirds of this large region is available. To help close this gap, we undertook a preliminary survey of the marine coast of Quirimbas National Park. The aims of our survey were (1) to assess species diversity and the numbers of waterbirds that use the park as a wintering area, and (2) to locate the most important roost sites.

Study area

Quirimbas National Park (Parque Nacional das Quirimbas (PNQ), 40°03'E 12°37'S) has an area of 7,506 km², which include an extensive inland ecosystem and 235.5 km of sea coast, of which 86.1 km (37%) comprises islands. The marine part of PNQ includes several coralline islands that form part of the Quirimbas archipelago. These islands range in size from 15 ha (Ilha das Rolas) to 30 km² (Ilha Matemo, Fig. 1). While most of the terrestrial coast is occupied by extensive mangrove forests (where *Rhizophora mucronata* is the dominant species), the islands usually possess rocky or sandy shores and a low, bush and thicket vegetation in the interior (with *Euclea* spp., *Salvadora persica*, *Commiphora* spp.). A tidal range of 3–4 m causes extensive coralline reefs to emerge every day at low tide. These reefs are mostly rocky and narrow (<1 km) around the smaller islands, but are broader (1–2 km) with large expanses of mud and sand around the larger ones, providing potential foraging areas for waterbirds.

Human population is quite dense along the coast of PNQ. Most islands have small fishing villages, but some of the smallest (Ilha das Rolas, Mogundula, Quisiva and Sencar) are uninhabited. The larger islands (Matemo, Ibo, Quirimbas) sustain agriculture and a relatively large human population (2,000–5,000 individuals). Fishing is intensive but practiced using traditional, low-impact techniques.

Methods

The survey was conducted on 8–17 December 2009 and focused on the area between Ilha Mogundula (c.2 km outside the northern boundary of PNQ, but protected by a private owner) and Ilha Quisiva (Fig. 1). We concentrated on the islands, because the mangrove forests on the terrestrial coast are inaccessible on foot. In total, we surveyed 53.7 km of coast on nine islands, representing 23% of the

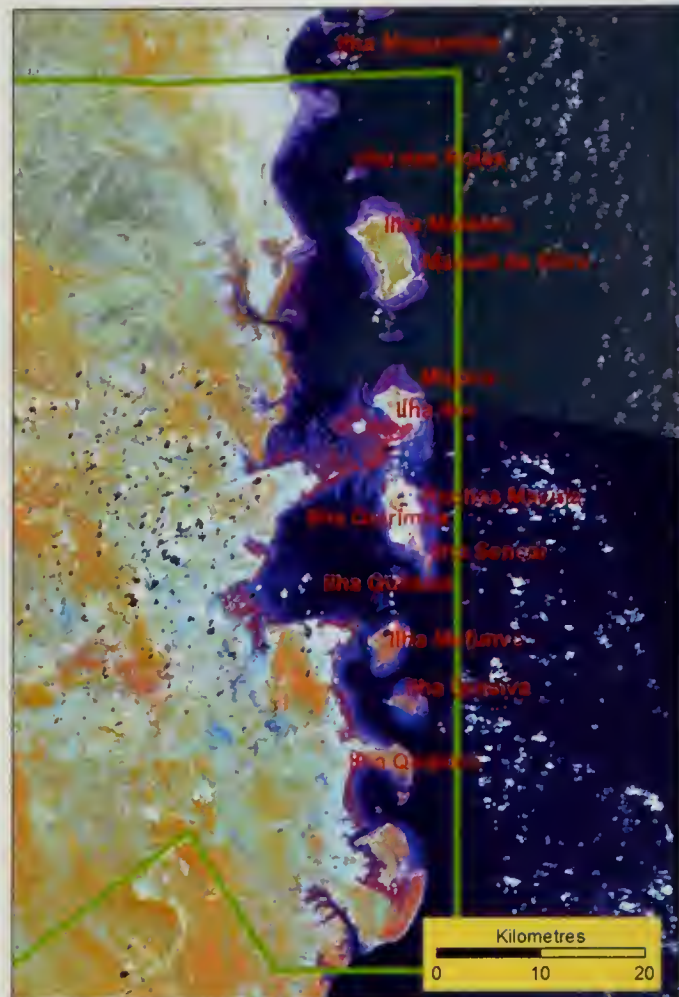


Figure 1. Map of the survey area (mosaic of two Landsat ETM+ images taken in December 1999 and May 2002). The green line marks the borders of Quirimbas National Park. In this infra-red satellite image, mangrove forests are dark red, sandy and muddy shores are white or pale turquoise, coral reef (emerging at low tide) ranges from azure to purple, while coastal bush/thicket is pale orange.

Carte de la zone inventoriée (combinaison de deux images Landsat ETM+ de décembre 1999 et mai 2002). La ligne verte marque les limites du Parc National de Quirimbas. Sur cette image satellitaire infra-rouge, les forêts de mangrove sont en rouge foncé, les côtes sablonneuses ou boueuses en blanc ou turquoise pâle, les récifs de corail (qui émergent à marée basse) varient d'azur à pourpre, et les fourrés côtiers sont en orange pâle.

coastal length of PNQ (and 63% of the islands, Table 1).

Preliminary observations revealed that, at low tide, waterbirds dispersed at low densities over vast stretches of emerging coral reef, making accurate counts impossible as most birds escaped detection. We therefore undertook counts at high tide and paid particular attention to locating large roosts. All counts were made by both authors,

Table 1. Sectors of the marine coast of Quirimbas National Park, Mozambique, visited during the survey.

Tableau 1. Les secteurs de la côte maritime du Parc National de Quirimbas, Mozambique, visités pendant l'inventaire.

Name of sector	Survey dates	Length of sector (km)	Length surveyed (km)	Percentage surveyed
Terrestrial coast	--	149.4	0	0.0%
Ilha das Rolas	09/12/2009	2.2	2.2	100.0%
Ilha Mogundula	09/12/2009	2.1	2.1	100.0%
Ilha Matemo	10–13/12/2009	21.9	14.4	65.8%
Ilha Ibo	12–13/09/2009	14.9	9.7	65.1%
Ilha Quirimba	14/12/2009	15.8	4.2	26.6%
Ilha Sencar	15/12/2009	4	2.5	62.5%
Ilha Quilalea	15/12/2009	2.7	2.7	100.0%
Ilha Mefunvo	16/12/2009	11.8	9.5	80.5%
Ilha Quisiva	17/12/2009	7.6	6.4	84.2%
Ilha Quipaco	--	3.1	0	0.0%
Total		235.5	53.7	22.8%

who worked together and identified birds using 8× binoculars and 25–50× spotting scopes.

Results

During the survey, 14,982 waterbirds of 34 species were observed; 82% of these were Palearctic migrants (Table 2). Five species (Lesser Crested Tern *Sterna bengalensis*, Crab-plover *Dromas ardeola*, Lesser Sand Plover *Charadrius mongolus*, Grey Plover *Pluvialis squatarola*, Curlew Sandpiper *Calidris ferruginea* and Whimbrel *Numenius phaeopus*) accounted for 66% (9,881 individuals) of the total. For seven species (marked * in Table 2), numbers exceeded the 1% thresholds of the Ramsar criterion.

The distribution of birds in the study area was uneven, as 66% of individuals were observed at four large roosts (Table 3) that covered a total of c.2.5 km (<4% of the length of coast surveyed). Abundance within roosts was also unevenly distributed across species. Whilst for some species the large majority of birds was observed in the four roosts (e.g., Crab-plover, Lesser Sand Plover, Grey Plover, Bar-tailed Godwit *Limosa lapponica*), for others most individuals were observed outside the roosts (e.g. White-fronted Plover *Charadrius marginatus*, Whimbrel, Common Sandpiper *Actitis hypoleucos*, Ruddy Turnstone *Arenaria interpres*; Table 3).

Discussion

PNQ was already known to host internationally important numbers of White-fronted Plovers (Diagana & Dodman 2007), but no detailed counts were available for other species. Our survey found c.15,000 waterbirds—a figure that we believe to be a substantial under-estimate of the real number. There are two main sources of under-estimation in our counts: incomplete coverage of the coast and inaccurate counts due to birds escaping detection. We now examine these sources of bias in more detail.

No counts were made on PNQ's terrestrial coast, which represents >60% of the park's coastline (Table 1). Substantial numbers of birds were thus probably missed. Moreover, this coast is largely covered in dense mangrove forest, a habitat preferentially used by some bird species for roosting. It is therefore probable that our results were particularly inaccurate for these species. Preliminary observations made during this survey, as well as previously published data (Borghesio *et al.* 2009) suggest that, among Charadriiformes, substantial numbers of Whimbrel, Common Greenshank *Tringa nebularia*, and Terek Xenus *cinereus* and Common Sandpipers use mangroves as high-tide roosts, as do other waterbirds, such as Great Egret *Egretta alba*, Yellow-billed Stork *Mycteria ibis* and Hadada Ibis *Bostrychia hagedash*. The wintering populations of these species at PNQ is probably >50% greater than suggested by our counts.

Our survey focused on the islands. In general, small islands off the African coast are important for waterbirds, as they are better protected from large mammalian predators and human disturbance. We covered 53.7 km of insular coast, which represents 62% of the coastline of the islands within PNQ. Assuming that bird abundance was constant, we can extrapolate that the total number of waterbirds on the islands might be up to 24,000 individuals.

Under-estimation is also likely because many birds, especially of the smallest species (e.g. Lesser Sand Plover, Greater Sand Plover *Charadrius leschenaultii*, Little Stint *Calidris minuta*, Curlew Sandpiper), tended to hide among coral rocks and may therefore escape detection.

Even though our total counts numbered <20,000 individuals, it is probable that the marine part of PNQ hosts many more waterbirds

Table 2. List of species and number of individuals observed. Species marked with asterisks are those whose censused population exceeds the 1% threshold of Ramsar criterion 6 (Ramsar Convention Secretariat 2006); 1% thresholds taken from Wetlands International (2006).

Tableau 2. Liste des espèces et nombre d'individus observés. Les espèces marquées d'un astérisque sont celles dont la population inventoriée dépasse le seuil de 1% du critère 6 de la Convention de Ramsar (Ramsar Convention Secretariat 2006) ; les seuils de 1% sont repris de Wetlands International (2006).

Species	Ibo	Rolas	Mogundula	Quilalea	Sencar	Matemo	Mefunvo	Quirimba	Quisiva	Total
ARDEIDAE										
Striated Heron <i>Butorides striata</i>	0	1	1	0	2	1	2	1	6	14
*Dimorphic Egret <i>Egretta dimorpha</i>	144	6	16	6	8	147	77	181	38	623
Great Egret <i>Egretta alba</i>	29	0	0	0	0	0	0	0	0	29
Grey Heron <i>Ardea cinerea</i>	1	0	0	0	0	0	1	0	0	2
Goliath Heron <i>Ardea goliath</i>	3	0	0	0	0	0	0	0	0	3
CICONIIDAE										
Yellow-billed Stork <i>Mycteria ibis</i>	172	0	0	0	0	0	11	0	0	183
Woolly-necked Stork <i>Ciconia episcopus</i>	1	0	0	0	0	0	2	0	0	3
THRESKIORNITIDAE										
Hadada Ibis <i>Bostrychia hagedash</i>	0	0	0	0	0	2	0	0	0	2
Sacred Ibis <i>Threskiornis aethiopicus</i>	26	0	8	0	0	11	0	85	0	130
PHOENICOPTERIDAE										
Greater Flamingo <i>Phoenicopterus ruber</i>	0	0	0	0	0	6	0	0	0	6
ACCIPITRIDAE										
Osprey <i>Pandion haliaetus</i>	1	0	0	0	0	2	0	0	0	3
African Fish Eagle <i>Haliaeetus vocifer</i>	1	1	0	2	0	0	2	1	1	8
DROMADIDAE										
*Crab-plover <i>Dromas ardeola</i>	0	0	180	0	1,250	0	2	1	0	1,433
BURHINIDAE										
Water Thick-knee <i>Burhinus vermiculatus</i>	0	0	2	0	0	0	0	0	0	2
CHARADRIDAE										
Common Ringed Plover <i>Charadrius hiaticula</i>	178	18	26	24	35	205	86	195	55	809
*White-fronted Plover <i>Charadrius marginatus</i>	155	0	0	5	14	29	42	28	8	277
*Lesser Sand Plover <i>Charadrius mongolus</i>	523	5	120	8	40	235	38	1,112	25	2,094
*Greater Sand Plover <i>Charadrius leschenaultii</i>	99	2	50	0	6	72	25	184	12	446
Pacific Golden Plover <i>Pluvialis fulva</i>	0	0	0	0	0	0	0	1	0	1
*Grey Plover <i>Pluvialis squatarola</i>	321	4	2	4	0	304	73	569	12	1,284
SCOLOPACIDAE										
Sanderling <i>Calidris alba</i>	113	0	1	0	3	175	24	148	0	456
Little Stint <i>Calidris minuta</i>	41	0	0	0	0	68	0	149	0	258
Curlew Sandpiper <i>Calidris ferruginea</i>	1,167	0	2	0	5	501	50	335	0	2,045
Bar-tailed Godwit <i>Limosa lapponica</i>	25	0	0	0	0	4	0	280	0	309
Whimbrel <i>Numenius phaeopus</i>	685	1	38	15	75	407	87	61	31	1,394
Eurasian Curlew <i>Numenius arquata</i>	0	0	0	0	0	0	0	1	0	1
Common Greenshank <i>Tringa nebularia</i>	265	0	0	6	18	93	45	28	0	455
Terek Sandpiper <i>Xenus cinereus</i>	123	0	69	0	0	99	0	125	0	416
Common Sandpiper <i>Actitis hypoleucos</i>	14	4	3	0	5	8	39	0	11	84
Ruddy Turnstone <i>Arenaria interpres</i>	87	40	40	21	45	86	24	46	45	434
STERNIDAE										
Greater Crested Tern <i>Sterna bergii</i>	0	0	3	0	0	27	0	3	0	33
*Lesser Crested Tern <i>Sterna bengalensis</i>	432	300	180	0	30	574	31	84	0	1,631
Common Tern <i>Sterna hirundo</i>	0	0	0	0	0	0	0	23	0	23
Little/Saunders's Tern <i>S. albifrons/S. saundersii</i>	0	0	0	0	0	13	0	11	0	24
Total	4,606	382	741	91	1,536	3,069	661	3,652	244	14,982

Table 3. Waterbirds observed at the four major roost sites.
Tableau 3. Oiseaux d'eau observés sur les quatre reposoirs les plus importants.

Species	Roost name				% in roosts
	Mujaca, Ilha Ibo	Manuel da Silva, Ilha Matemo	Macula rocks, Ilha Quirimba	Ilha Sencar	
Striated Heron <i>Butorides striata</i>	0	0	1	2	21%
egrets <i>Egretta</i> spp.	24	107	181	8	51%
Goliath Heron <i>Ardea goliath</i>	2	0	0	0	67%
Yellow-billed Stork <i>Mycteria ibis</i>	49	0	0	0	27%
Sacred Ibis <i>Threskiornis aethiopicus</i>	7	8	85	0	77%
African Fish Eagle <i>Haliaeetus vocifer</i>	1	0	1	0	25%
Crab-plover <i>Dromas ardeola</i>	0	0	1	1,250	87%
Common Ringed Plover <i>Charadrius hiaticula</i>	75	116	182	35	49%
White-fronted Plover <i>Charadrius marginatus</i>	25	29	24	14	33%
Lesser Sand Plover <i>Charadrius mongolus</i>	440	94	1,100	40	80%
Greater Sand Plover <i>Charadrius leschenaultii</i>	55	36	180	6	62%
Pacific Golden Plover <i>Pluvialis fulva</i>	0	0	1	0	100%
Grey Plover <i>Pluvialis squatarola</i>	299	242	564	0	86%
Sanderling <i>Calidris alba</i>	97	135	140	3	82%
Little Stint <i>Calidris minuta</i>	23	41	149	0	83%
Curlew Sandpiper <i>Calidris ferruginea</i>	901	358	320	5	77%
Bar-tailed Godwit <i>Limosa lapponica</i>	25	4	280	0	100%
Whimbrel <i>Numenius phaeopus</i>	247	148	55	75	37%
Eurasian Curlew <i>Numenius arquata</i>	0	0	1	0	100%
Common Greenshank <i>Tringa nebularia</i>	150	66	28	18	58%
Terek Sandpiper <i>Xenus cinereus</i>	109	92	125	0	78%
Common Sandpiper <i>Actitis hypoleucos</i>	0	0	0	5	6%
Ruddy Turnstone <i>Arenaria interpres</i>	46	64	46	45	46%
Greater Crested Tern <i>Sterna bergii</i>	0	26	3	0	88%
Lesser Crested Tern <i>Sterna bengalensis</i>	432	124	84	30	41%
Common Tern <i>Sterna hirundo</i>	0	0	23	0	100%
Little/Saunders's Tern <i>S. albifrons</i> / <i>S. saundersii</i>	0	13	11	0	100%
Total	3,007	1,703	3,585	1,536	66%

than this during the boreal winter. Therefore, we provide initial evidence that PNQ is an internationally important waterbird area, as it fulfils the requirement of criterion 5 (>20,000 waterbirds regularly present in the area) of the Ramsar Convention (Ramsar Convention Secretariat 2006).

Our survey was conducted in December, when Palearctic migrants have usually reached their wintering grounds, and indeed no migratory movements were observed. Although preliminary observations suggest that large numbers of

migrants use the Quirimbas archipelago as a stopover site in October (Wilson 2008), more research is needed to assess the importance of PNQ in September–November for waterbirds moving further south.

The largest numbers of birds were located on or close to the three largest islands of the archipelago (Matemo, Ibo and Quirimba). These possess vast expanses of sandy and muddy reefs at low tide (Fig. 1), providing suitable foraging areas for waterbirds. The small islands (Quilalea, Quisiva, Mefunvo) have much narrower reefs

and therefore tend to support smaller numbers of birds, with the exception of Sencar, where a large roost (mostly of Crab-plovers) was found. As Sencar is close to Quirimba (the two islands are connected at low tide), we can hypothesise that birds roosting on Sencar forage on the coral reefs around Quirimba.

Birds were largely concentrated at four high-tide roosts, which totalled about two-thirds of the total number of birds counted. One of these roosts was sited on a small island with no human population (Sencar), two were on tiny rocks a few hundred metres from a large island (Manuel da Silva, close to Matemo and Macula rocks, near Quirimba). The fourth roost was on a small rocky peninsula (Mujaca) in an uninhabited sector of Ibo. This suggests that disturbance (from humans or other terrestrial predators) is an important factor determining the distribution of roosting sites. It is therefore important that these four sites be maintained free of disturbance, e.g. by regulating settlements and human activities in the area.

Of the 34 species observed, six qualified for Ramsar criterion 6 (wetlands supporting 1% of the individuals in a population of a species or subspecies of waterbird). However, difficulties in the identification of some species might have compromised the results of our counts. *Charadrius mongolus* and *C. leschenaultii* pose an identification problem, even though the race *C. leschenaultii columbinus*, which is almost indistinguishable from *C. mongolus*, is not found in Mozambique, where only *C. l. leschenaultii* seems to occur (Hirschfeld *et al.* 2000, Delany *et al.* 2009). We suspect that some *C. leschenaultii*, especially among individuals seen at longer distances, might have been incorrectly identified as *C. mongolus*, as the distinction of the two species relies on subtle details of bill and head morphology (Hirschfeld *et al.* 2000). If true, then numbers of *C. leschenaultii* in Table 2 would be biased low, while counts of *C. mongolus* would be biased high. This would stress the importance of PNQ as an internationally important site for *C. leschenaultii* (whose 1% level is 380 individuals), without denying the importance of the area for *C. mongolus* which, according to our counts, vastly surpassed the 1% threshold of 1,250 individuals proposed for this species by Wetlands International (2006).

Egrets represent another identification problem. Based on the field identification characters provided by Zimmerman *et al.* (1996), we consider that *E. garzetta* and *E. gularis* were very rare or even absent in the Quirimbas during our survey and that *E. dimorpha* was by far the most numerous of the three species in the study area. This is also corroborated by the fact that the majority (55% of 480 adults) of individuals were of the black morph, which is more abundant than the white morph in *E. dimorpha* (Zimmerman *et al.* 1996). However, for individuals seen at long distances, or whose legs were stained with mud, we cannot eliminate the possibility of confusion with *E. garzetta* and *E. gularis*, which have also been observed in the area (M. Wilson pers. comm). For this reason, in Table 2, we list all small egrets as *E. dimorpha* / *garzetta* / *gularis* and suggest that more research is needed to confirm the specific identification of these egrets on the northern Mozambique coast. Even if small numbers of *E. garzetta* or *E. gularis* were misidentified as *E. dimorpha*, it still seems likely that PNQ is an internationally important site also for *E. dimorpha*, as the 1% level for this species (130 individuals: Wetlands International 2006) is far surpassed by our counts of more than 600 individuals. *E. dimorpha* might therefore be another species with internationally important numbers in the study area.

Conclusion

Our survey contributed to improving the knowledge of an area that has always figured as a largely blank spot on the distribution maps of African birds. We provide preliminary data that PNQ is an internationally important site for both Palearctic and African waterbirds. Further research is required to confirm the regular presence of important numbers of waterbirds in the area, as well as for elucidating the importance of PNQ as a stopover site for migrants heading further south in September–November or returning north in February–April.

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References

- Borghesio, L., Amakobe, B., Bakari, S., Balidy, H., Biasiol, D. & Menomussanga, M. 2009. A bird survey of the Ruvuma Delta, northern Mozambique. *Bull. ABC* 16: 197–203.
- Davidson, N. C. & Stroud, D. A. 2006. African-Western Eurasian flyways: current knowledge, population status and future challenges. In Boere, G. C., Galbraith, C. A. & Stroud, D. A. (eds.) *Waterbirds Around the World*. Edinburgh: The Stationery Office.
- Delany, S., Scott, D., Dodman, T. & Stroud, D. (eds.) 2009. *An Atlas of Wader Populations in Africa and Western Eurasia*. Wageningen: Wetlands International.
- Diagana, C. H. & Dodman, T. (eds.) 2007. *Numbers and Distribution of Waterbirds in Africa: Results of the African Waterbird Census, 2002, 2003 and 2004*. Dakar: Wetlands International.
- Hirschfeld, E., Roselaar, C. S. & Shirihai, H. 2000. Identification, taxonomy and distribution of Greater and Lesser Sand Plovers. *Br. Birds* 93: 162–189.
- Kabii, T. 1997. The Ramsar Convention: a perspective on Africa. In Dodman, T. (ed.) *A Preliminary Waterbird Monitoring Strategy for Africa*. Wageningen: Wetlands International.
- Kirby, J. S., Stattersfield, A. J., Butchart, S. H. M., Evans, M. I., Grimmett, R. F. A., Jones, V. R., O'Sullivan, J., Tucker, G. M. & Newton, I. 2008. Key conservation issues for migratory land- and waterbird species on the world's major flyways. *Bird Conserv. Intern.* 18: S49–S73.
- Ramsar Convention Secretariat. 2006. *The Ramsar Convention Manual: A Guide to the Convention on Wetlands (Ramsar, Iran, 1971)*. Fourth edn. Gland: Ramsar Convention Secretariat.
- Scott, D. A. & Rose, P. M. (eds.) 1996. *Atlas of Anatidae Populations in Africa and Western Eurasia*. Wageningen: Wetlands International.
- Stroud, D. A., Boere, G. C., Galbraith, C. A. & Thompson, D. B. A. 2006. Waterbird conservation in a new millennium—where from and where to? In Boere, G. C., Galbraith, C. A. & Stroud, D. A. (eds.) *Waterbirds Around the World*. Edinburgh: The Stationery Office.
- Vincent, J. 1933. The birds of Northern Portuguese East Africa. Comprising a list of, and observations on, the collections made during the British Museum Expedition of 1931–32. Part I. *Ibis* 75: 611–652.
- Wetlands International. 2006. *Waterbird Population Estimates*. Fourth edn. Wageningen: Wetlands International.
- Wilson, M. 2008. Avitourism and bird ringing site assessment report Quirimbas National Park and Pemba area, October 14th to 28th 2008. www.wwf.org.mz (accessed 1 December 2009).
- Zimmerman, D. A., Turner, D. A. & Pearson, D. J. 1996. *Birds of Kenya and Northern Tanzania*. Princeton, NJ: Princeton University Press.
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